

Xenon Flash Lamp Power Supply

C6096-02

INSTRUCTION MANUAL



- This power supply has a special structure designed to be built into equipment. Use this power supply only as a built-in unit for equipment.
- Read this instruction manual carefully before attempting to operate or service this product. Do not attempt to operate or service this product until you completely understand the contents of this instruction manual. Attempting to operate this product by methods different from those described in this instruction manual may cause serious accidents.
- Those responsible for this product must not allow personnel to operate or service it unless they thoroughly understand this instruction manual.
- Keep this instruction manual near the product for easy reference when needed.
- If this instruction manual is lost or damaged, promptly order a replacement copy from our company or sales office.
- If transferring this product to another party, make sure that this instruction manual is included along with the product.

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The contents of this manual are subject to change without prior notice.

No part of this manual may be reproduced or copied without permission of Hamamatsu Photonics.

If any of the following problems are found, please contact our sales office, so we can quickly take corrective measures .

- When omissions, errors or dubious points are found in the text
- When problems such as the wrong page order or missing pages are found
- When this manual was lost, soiled or damaged

1. Safety precautions

Before using this product, be sure to read the safety precautions in this section carefully and comply with the instructions.

1-1 Warning symbols and signal words

Warning symbols and signal words used in this manual and product are classified as explained below. Make sure that you fully understand the meaning of each symbol and comply with the instructions.



DANGER

"DANGER" indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

"WARNING" indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

"CAUTION" indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury or damage to the equipment.



These warning symbols indicate a caution or warning you must heed. The specific caution or warning is often indicated by a pictorial sign. Always follow these instructions to ensure correct and safe product use.



These symbols indicate a prohibited action. The specific prohibited action is often indicated by a pictorial sign. Never attempt the prohibited action.



This symbol indicates a mandatory action. The specific instruction is often indicated by a pictorial sign. Read the instructions carefully and always use the specified procedure.



This symbol indicates hazardous UV radiation.



This symbol indicates a direct current (voltage and current).

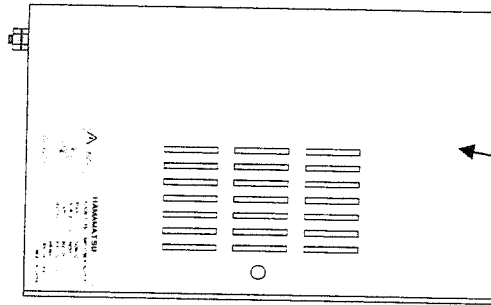
1-2 Precautions

●High voltage hazard



CAUTION

Do not remove the cover during operation. There is a risk of high-voltage electrical shock. A high voltage (1000 V) is output inside the power supply during lamp operation.



Cover

This label indicates a high voltage hazard.

●Vibration and shock



WARNING

Carefully handle this power supply.

The internal parts of this power supply are precisely adjusted. Excessive vibration or shock may impair the adjustment and lead to fire or electrical shock.

●Do NOT modify any part .



Do NOT remove any cover of this power supply. Do NOT adjust or modify any part of this power supply since the internal parts are precisely adjusted. Improper adjustment or modification may cause this power supply to malfunction and lead to fire or electrical shock.

●If an abnormality occurs...



If smoke or unusual odor is emitted from this power supply or other abnormal conditions occur, immediately turn off the input power (24 V DC) to this power supply. Continuous operation under such abnormal conditions might result in fire or electrical shock.

●Cable connection



Securely connect the cable to the input connector of this power supply. Loose or improper connection may cause malfunction.

●Operating environment



CAUTION

This power supply is designed and tested for use in industrial environments. EMI (electro-magnetic interference) might occur if this power supply is used in the home environments. In such cases, the user should take appropriate EMI countermeasures.

●Installation location



CAUTION

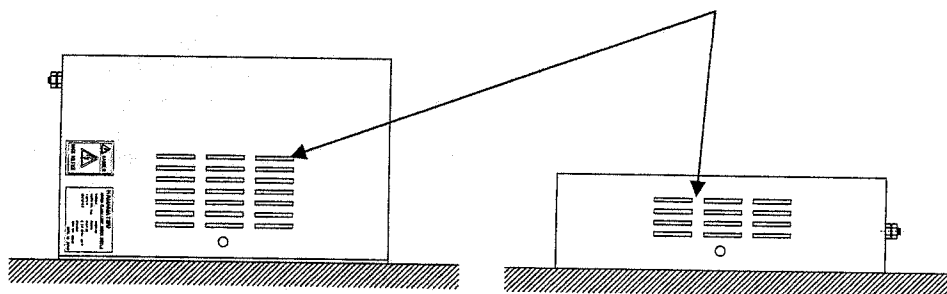
When using this power supply by natural air cooling, install it in locations with sufficient convection and do not block the air vents.

Allow a clearance of at least 15 mm (Recommended 30 mm) around the power supply.

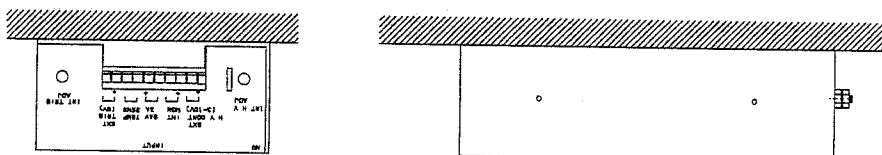
Also avoid installing this power supply in locations exposed to high temperature, high humidity, water or other liquids. Installing in such locations might result in malfunction or fire or electrical shock.

●Installation orientation

Air vents



We recommend not installing this power supply in the downward orientation on the bottom panel as shown below.

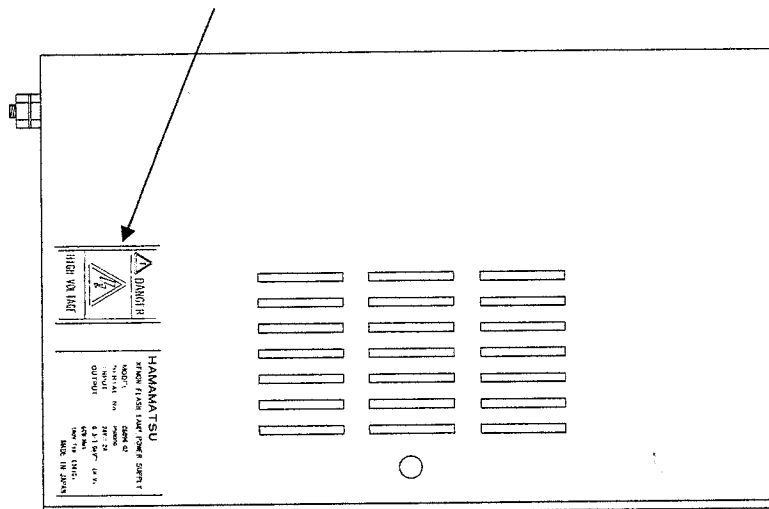


1-3 Warning label attachment position



The warning label affixed to the product (see below) must be clearly seen at all times. If the warning label starts to peel off or becomes dirty, replace it with a new label. Please contact our sales office for a replacement label (available for a fee).

Warning label



Top view showing warning label position
(Label position is the same on C10979 and C10980 series.)

2. Overview

This power supply is designed for stable operation of xenon flash lamps (pulse lighting type) that were developed for photometric applications and emit an intense continuous light spectrum spanning the UV through infrared range. This power supply is compact yet ensures higher stability and higher output up to a maximum of 60 W.

This power supply is designed to exhibit the full performance of lamps when used in combination with a dedicated trigger socket.

This power supply (Model: C6096-02) is RoHS compliant products of the conventional model (Model: C6096).



When using this power supply to operate a lamp made by other manufacturers, make sure that their electrical specifications match. If you are not sure, check the lamp manufacturer name, lamp model number, and the following specifications, then contact us for advice.

Electrical specifications:

Operating voltage range, trigger voltage, maximum input energy, maximum repetition rate, etc.

3. Features

- **Stable low-loss power supply (charge accumulation method)**

Main discharge voltage

adjustable range (DC)..... 300 V to 1000 V (700 to 1000 V recommended)

Voltage range when internal main discharge voltage adjustment trimmer is used.

External control possible (DC).... 300 V to 1050 V (Input DC voltage: 3.6 to 10.6 V)

Stability..... ± 0.5 %

- **Built-in pulse generator**

10 Hz to 100 Hz variable

- **Light emission at high repetition rate**

Emits light flashes at a repetition rate up to a maximum of 100 Hz (rectangular wave +5 V ± 0.5 V).

- **Compact and lightweight**

Dimensions 108 (W) \times 174 (D) mm \times 49 (H) mm

Weight Approx. 534 g

4. Configuration

This power supply comes with the following items.

After unpacking, first check that all items are included and there is no shipping damage. If any item is damaged or missing, please contact us as soon as possible.

C10979/C10980 series

- Main unit 1
- Instruction manual (this manual)..... 1

5. Part names and functions

5-1 Input connectors

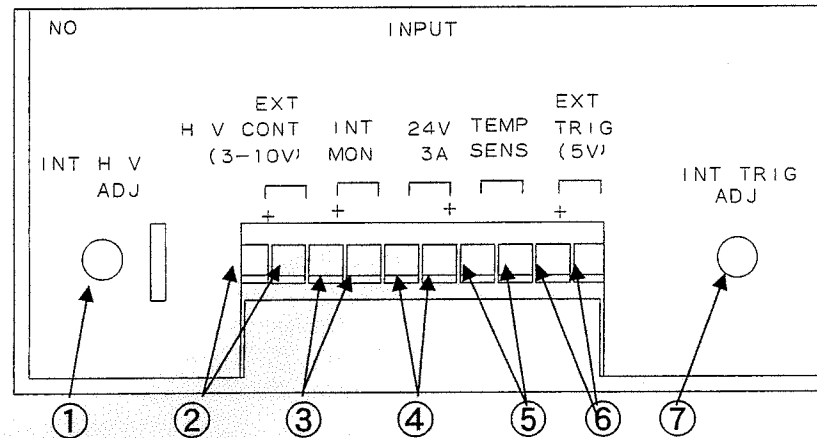


Figure 1: Input side terminal diagram

① **Internal trimmer for adjusting main discharge voltage (INT HV ADJ)**

Use this INT HV ADJ trimmer to adjust the voltage applied to the xenon flash lamp in a range from approx. 300 V to 1000 V. (Recommended operating voltage range: 700 V to 1000 V) Turn this trimmer clockwise to increase the main discharge voltage, and turn it counterclockwise to reduce the main discharge voltage.

This trimmer adjusts the output energy (per flash) to the xenon flash lamp.

Trimmer is set to "Max. (Approx. 1000 V)" at the factory before shipping.

NOTE: Set the selector switch ⑪ on the printed circuit board to "INT." (See page 12.)

② **External discharge voltage adjustment terminals**

Supply a DC current (3.6 V to 10.6 V) to the EXT HV CONT terminal from an external source to adjust the main discharge voltage applied to the xenon flash lamp in a range from 300 V to 1050 V.

(Recommended operating voltage range: 700 to 1000 V, External DC voltage: 7.4 V to 10.6 V)

NOTE: Set the switch ⑪ on the printed circuit board to "EXT." (See page 12.)

③ **Main discharge voltage monitoring terminals**

These terminals are used to monitor the main discharge voltage. Approximately one hundredth of the main discharge voltage while monitoring it by connecting a multimeter to these terminals.



When the output voltage from these terminals is fed to a device such as an AD converter, the main power supply noise may cause erroneous operation, so isolation the device is recommended.

④ **Supply voltage input terminals (24 Vdc)**

Supply a DV voltage ($24\text{ V} \pm 5\%$) to these terminals. Use a power source with a capacity of 3.0 A or more.

⑤ **Protective circuit (thermal sensor) terminals**

The output from the C6096-02 power supply can be shut off by shorting these terminals. Connect the thermal sensor leads coming out of the cooling jacket (E6611: sold separately) to these terminals. The C6096-02 power supply stops when the terminal sensor in the heat-sink jacket turns on, and re-starts when it turns off. (The E6611 cooling jacket is present so that the built-in thermal sensor turns on when the interior temperature reaches approximately 70 deg. C)

⑥ **External trigger signal input terminals**

Supply trigger signals to these terminals from an external pulse generator.

NOTE: Set the selector switch ⑫ on the printed circuit board to "EXT." (See page 12.)

⑦ **Internal trimmer for adjusting flash repetition rate (INT TRIG ADJ)**

Use this trimmer to adjust the repetition rate of the internal pulse generator.

Turn this trimmer clockwise to increase the repetition rate, and turn it counterclockwise to reduce the repetition rate. (Adjustable repetition rate range: Approx. 10 Hz to approx. 100 Hz)

Trimmer is set to "Min. (10 Hz)" at the factory before shipping.

NOTE: Set the selector switch ⑫ on the printed circuit board to "INT." (See page 12.)

● **Main (external) capacitor value**



The C10979 contains a main capacitor of 0.1 μ F. The input energy (J) per pulse of xenon flash lamps can be changed as shown in the formula below by attaching an external main capacitor. When externally connecting a main capacitor, select the capacitor value according to the following formula and make sure that the input energy does not exceed the lamp's maximum rating.

$$E (J) = 1 / 2 \times C_m \times V_m^2$$

E : Flash input energy per pulse

C_m : Main discharge capacitance

(internal capacitor 0.1 μ F + external capacitor)

V_m : Main discharge voltage

The connection cable for the external capacitor should be as short as possible in a range between 15 cm and 30 cm. A cable longer or shorter than this range will adversely affect the lamp because it changes the cable L (reactance) component, causing unstable operation and a shorter lamp life.

If using a capacitor other than those available as options from Hamamatsu, please consult our sales office.

The C10980 series contains a main capacitor whose value can be adjusted at the factory before shipping in a range from 0.2 to 1.0 μ F in 0.1 μ F steps

5-2 Output connector

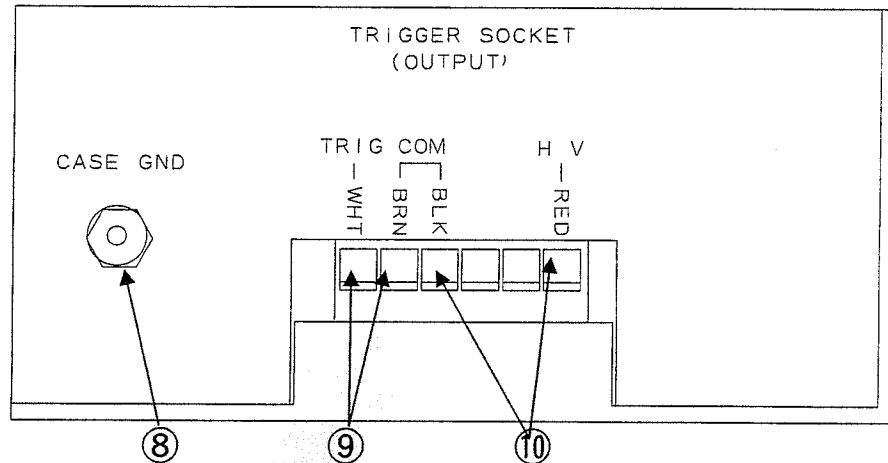


Figure 2: Output terminal diagram

⑧ Case ground terminal (CASE GND)

Terminal for connecting and grounding the trigger socket shield wire.

⑨ Trigger voltage output terminals (TRIG WHT, COM BRN)

Terminals for outputting a trigger voltage to the dedicated trigger socket.

The COM terminals are common to ⑧ and ⑨.

⑩ Main discharge voltage output terminals (HV RED, COM BRN)

Terminals for outputting a main discharge voltage to the dedicated trigger socket.

The COM terminals are common to ⑧ and ⑨.

5-3 Printed circuit board

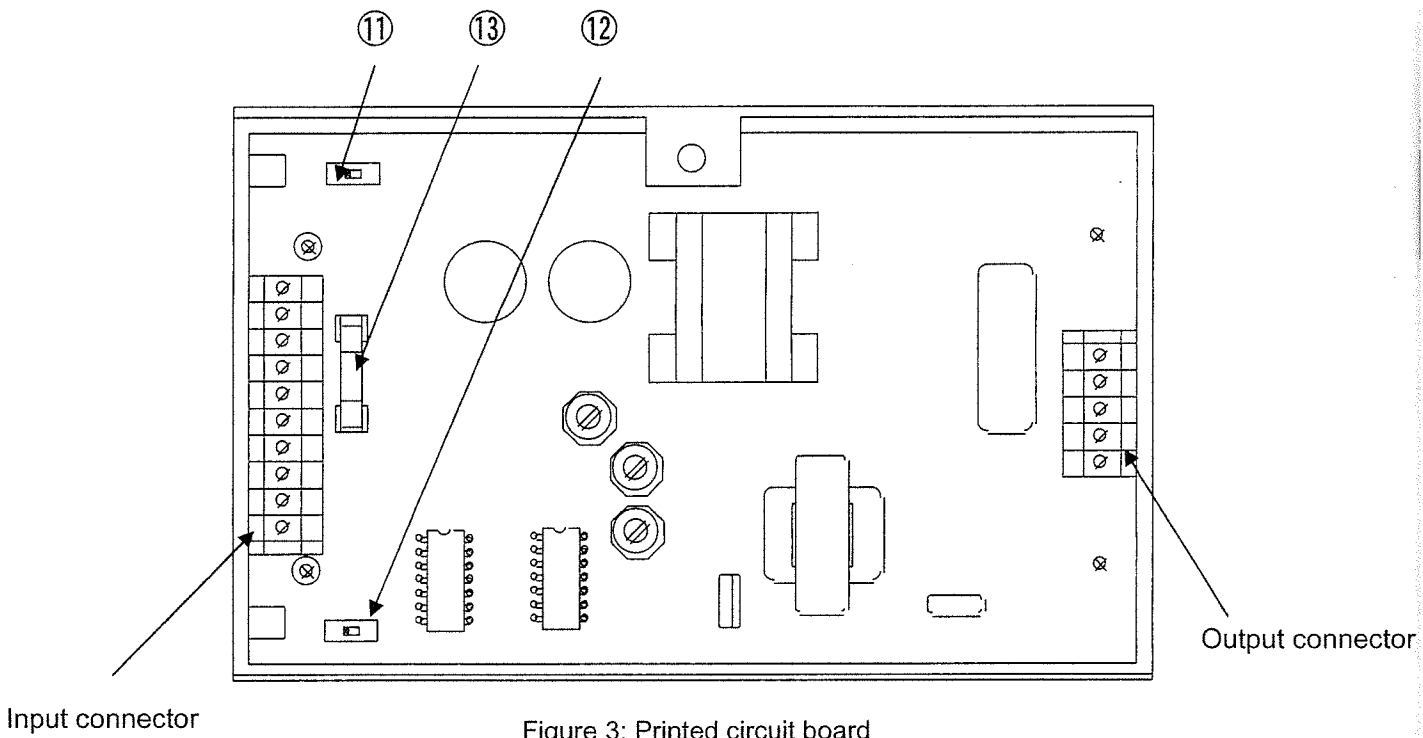


Figure 3: Printed circuit board

⑪ Main discharge voltage mode selector switch (INT/EXT)

Set this selector switch to "INT" when adjusting the main discharge voltage with the INT HV ADJ trimmer.

Set this selector switch to "EXT" when adjusting the main discharge voltage via the external adjustment terminals.

Switch is set to "INT." at the factory before shipping.

⑫ Trigger signal (flash repetition rate) mode selector switch (INT/EXT)

Set this selector switch to "INT" when adjusting the flash repetition rate with the INT TRIG ADJ trimmer.

Set this selector switch to "EXT" when operating the lamp with external trigger signals.

Switch is set to "INT." at the factory before shipping.

⑬ Fuse

This fuse has a rating of 4 A (amperes).

6. How to use

After unpacking, check this power supply for any damage that might have occurred during shipment. If any sign of damage is found, please notify us as soon as possible.

6-1 Setup for operation

To use this power supply, follow the procedure explained below. Before handling this power supply, check to make sure that no power (DC24 V \pm 5 %) is supplied to it.

●High voltage hazard



WARNING

The power supply circuit outputs a high voltage. Always turn off the input power (DC24 V) before making any connection or adjustment.

Even after the power is turned off, an electric charge remains for several seconds to a minute or more in the main capacitor, main discharge circuit, and trigger circuit, posing a risk of electrical shock, so do not begin adjustment until this electric charge is dissipated.

6-1-1 How to connect lead wires

- (1) Remove the two screws on the enclosure case and remove the top cover (Figure 4)
- (2) As shown in Figure 5, insert the tip of a lead wire into the terminal and tighten the screw from above with a flat-head screwdriver (we recommended using a screwdriver with a shaft diameter of 3 mm and a blade width of 2.6 mm). Securely tighten the screw so that the lead wire will not come loose.

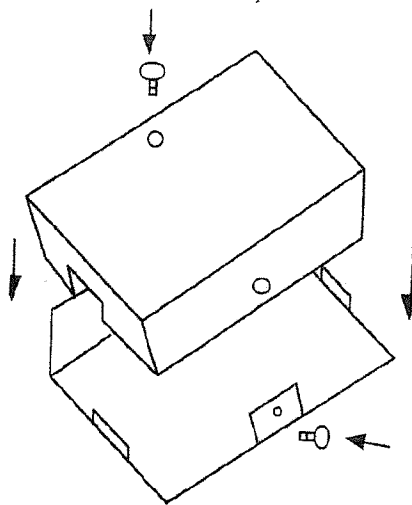


Figure 4

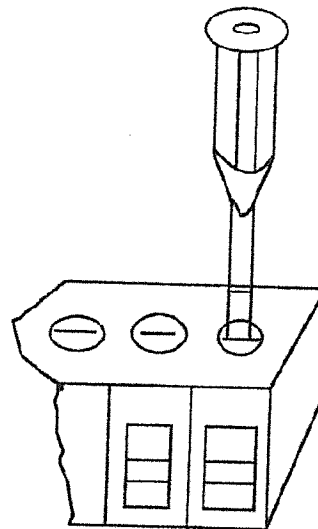


Figure 5

6-1-2 Connecting a lamp to the trigger socket

Insert a lamp into the trigger socket. Make sure there is no looseness or play.



CAUTION

Inserting the lamp into the socket might be difficult if the lamp leads are bent, so handle the lamp gently. If the lamp leads are bent, then use tweezers or a similar tool to straighten the leads while making sure not to apply any mechanical stress to the glass bulb.

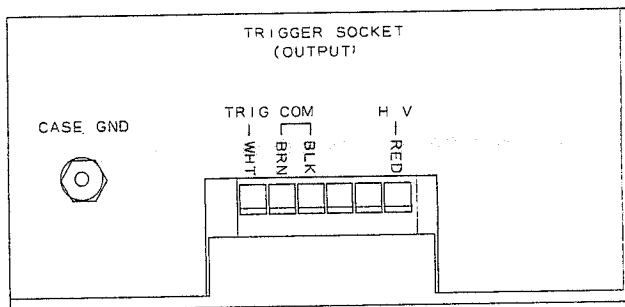
If a lamp with bent leads is forcibly inserted into the socket, the glass bulb might crack causing a hazardous situation.

The lamp is filled with high-pressure gas, so handle it with extreme care.

6-1-3 Connecting the trigger socket

Xenon flash lamps cannot be directly connected to the power supply. The dedicated trigger socket must be used to connect a lamp to the power supply.

Connect the trigger socket lead wires to the OUTPUT terminals of this power supply as shown below.



Trigger socket model No.

E6647

Indication on power supply

Red lead wire	_____	H.V. (RED)
Black lead wire	_____	H.V. COM. (BLK)
White lead wire	_____	TRIG. (WHT)
Brown lead wire	_____	TRIG. COM. (BRN)
Shield wire	_____	CASE GND.



CAUTION

Xenon flash lamps cannot be directly connected to this power supply. The dedicated trigger socket must be used to connect a lamp to the power supply.

Do not modify the trigger socket cable that was shipped to you. If the cable length is changed, this will adversely affect the lamp due to the resulting change in the cable L (reactance) component, causing unstable operation and shortening the lamp life.

When inserting lead wires from the trigger socket and external capacitor into the terminals, strip away the sheath to expose $7\text{ mm} \pm 2\text{ mm}$ of bare wire. Failure to follow this instruction might cause poor contact with the contactor, resulting in extremely hazardous situations and malfunctions.

When using the External is change capacitance, please make sure that power supply output is not higher than 60W.

The output energy (per flash) to the xenon lamp is determined by the main discharge capacitance and main discharge voltage as shown by the equation below. The wattage is determined by the output energy and repetition rate.

NOTE: A main discharge capacitor of 0.1 μF is mounted in the power supply.

$$E (\text{J}) = 1/2 \times C_m \times V_m^2 \dots\dots\dots [\text{Eq.1}]$$

E : Flash input energy per pulse
 C_m : Main discharge capacitance
 V_m : Main discharge voltage

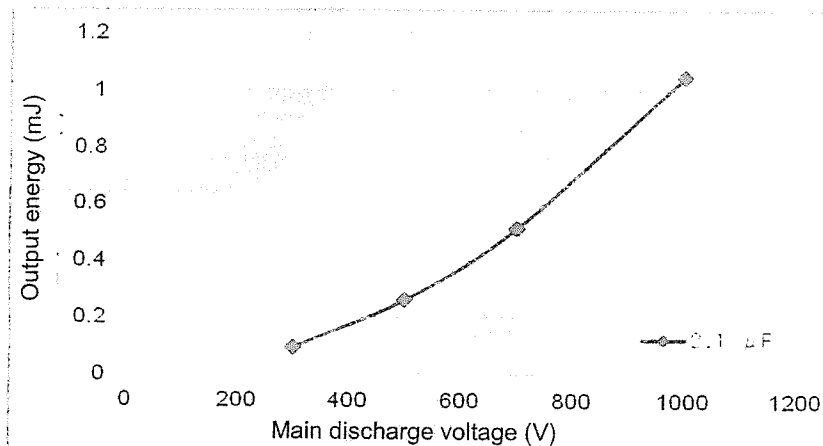


Figure 6: Output energy vs. main discharge voltage and capacitance

The maximum wattage of this power supply is 60 W, which is calculated by multiplying the flash repetition rate by the energy per pulse (E in Eq. 1).

$$P (\text{W}) = E \times f \dots\dots\dots [\text{Eq.2}]$$

P : Power
E : Flash input energy per pulse
f : Flash repetition rate

Equations 1 and 2 give the relation between the flash repetition rate and the main discharge capacitance as shown in Figure 7 below.

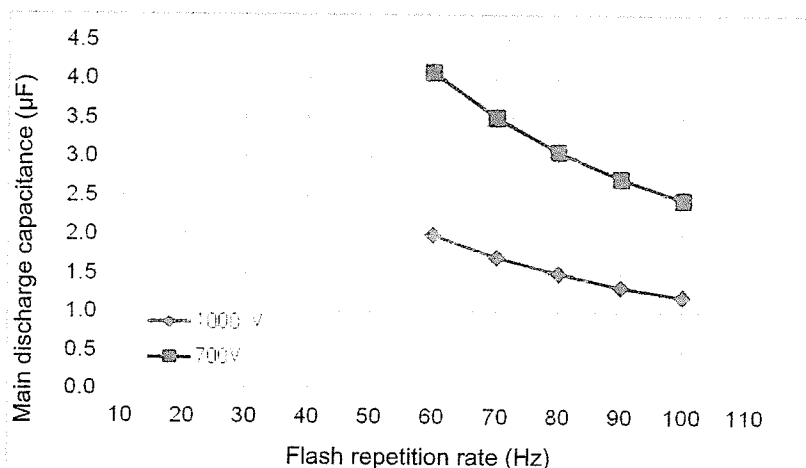


Figure 7: Flash repetition rate vs. main discharge capacitance

6-1-4 Installing and grounding the power supply unit

Install the power supply unit (enclosure case) with the mounting screws (M3 - 2 places). Also ground the power supply unit using the CASE GND terminal on the enclosure case.

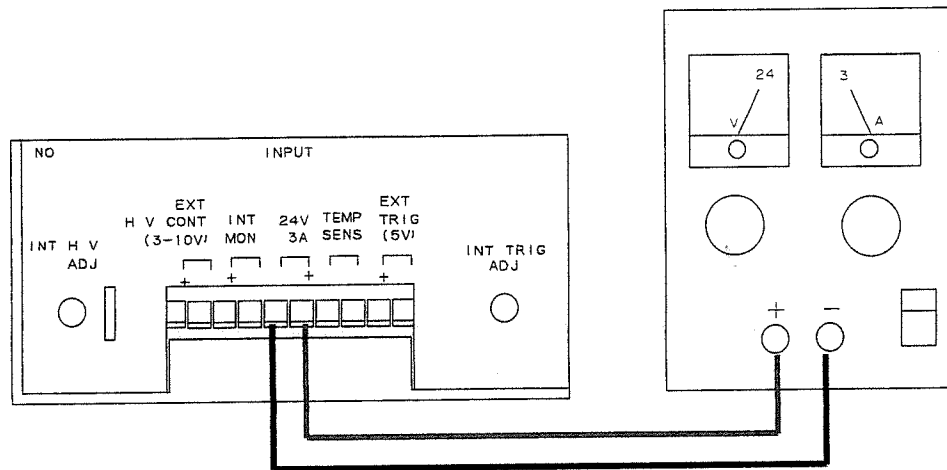
6-1-5 Changing the main discharge voltage and trigger signal modes

Using a precision screwdriver or a similar tool, set the main discharge voltage and flash repetition rate selector switches to "INT" (internal) or "EXT" (external) according to how this power supply will be used. Both of these selector switches are set to "INT" at the factory before shipping.

6-1-6 Connection to the INPUT terminals (Drive power supply)

(1) Connecting the input power supply

Connect the 24 V DC power (current capacity of 3 A or more) to the INPUT terminals (24 V, 3 A) on the input side of this power supply.

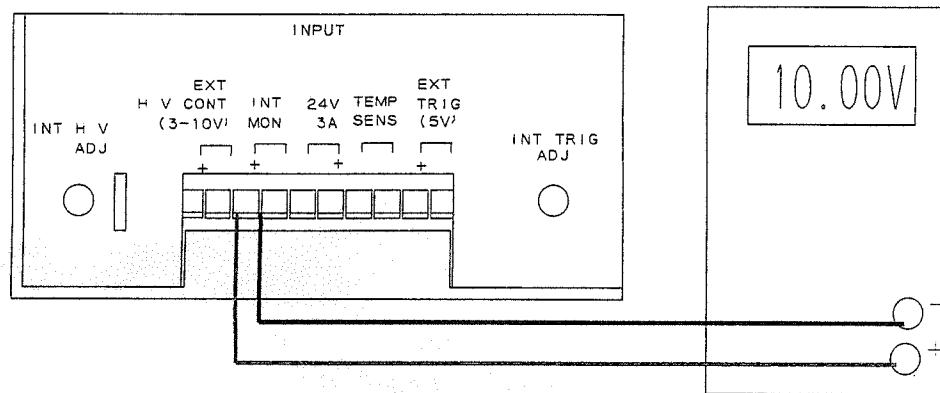


CAUTION

Before supplying the 24 V DC, be sure to connect the trigger socket/lamp to this power supply because a high voltage will be generated from the output terminals at the same time that the 24 V DC is applied.

6-1-8 Connection to the INPUT terminals (Monitoring terminals)

When monitoring the main discharge voltage by connecting a multi meter to Monitoring terminals, Please adjust the main discharge voltage.
Monitoring terminals output one hundredth of the main discharge voltage.



6-1-9 Connection to the INPUT terminals (When adjusting the main charge voltage with an external source)

When adjusting the main discharge voltage from an external source, supply a DC voltage (3.6 V to 10.6 V) to the INPUT terminals (EXT HV CONT +,-) on the input side of this power supply. Also set the main discharge voltage selector switch ⑪ on the printed circuit board to "EXT" (see page 12).

NOTE: See ⑪ on page 9 when adjusting the main discharge voltage with the internal main discharge adjustment trimmer.

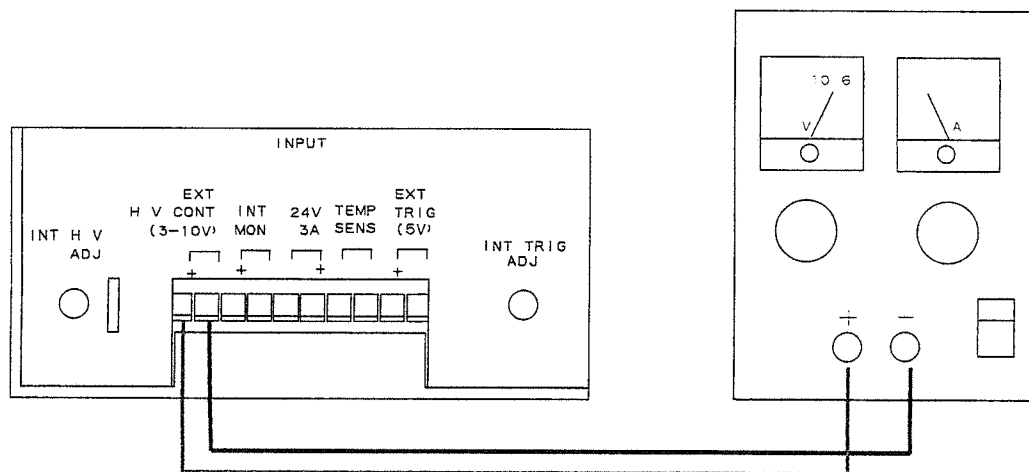


Figure 3 below shows the relation between the main discharge voltage and the external input voltage.

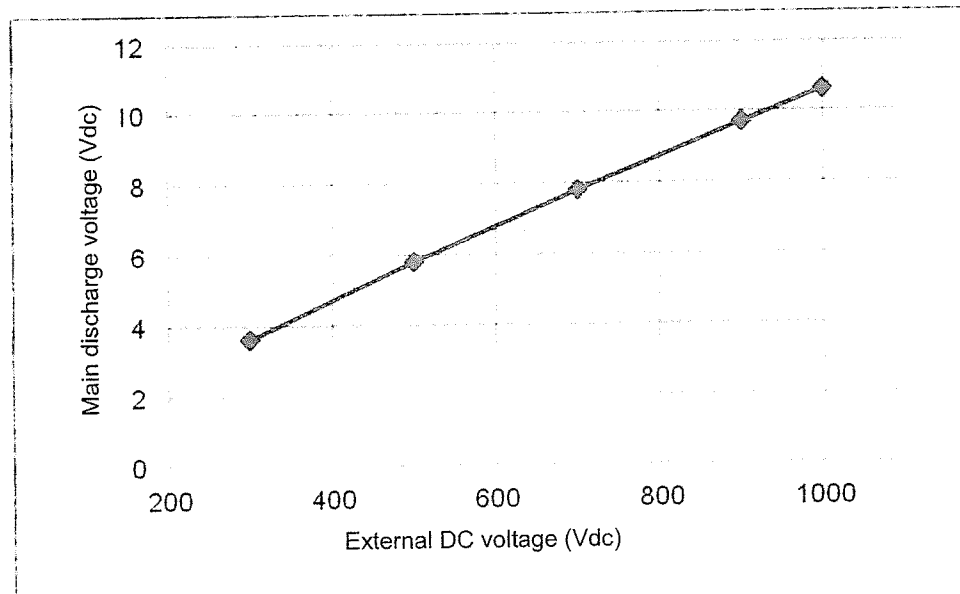
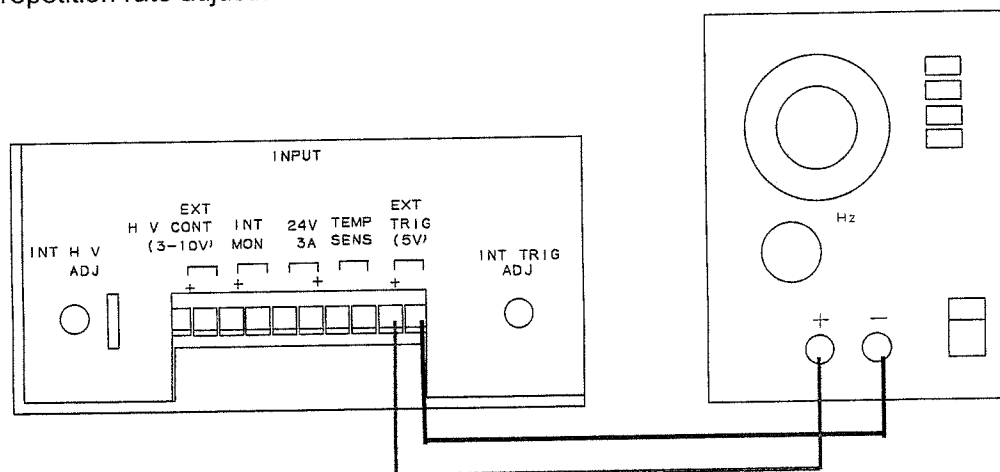


Figure 3: Main discharge voltage vs. external DC voltage

6-1-10 Connection to the INPUT terminals (When adjusting the flash repetition rate with external trigger signals)

When adjusting the flash repetition rate using an external pulse generator, connect the pulse generator to the INPUT terminals (EXT TRIG, 5 V \pm 0.5 V) on the input side of this power supply. Then supply rectangular-wave trigger signals (pulse width of 5 μ s or more) as shown below. Also set the flash repetition rate selector switches ⑫ on the printed circuit board to "EXT" (see page 12).

NOTE: See ⑦ on page 10 when adjusting the flash repetition rate with the internal flash repetition rate adjustment trimmer.



●External trigger signal

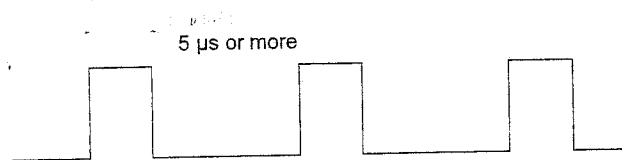


Figure 4: Trigger input waveform

Trigger input specifications

Input signal voltage	: +5 V \pm 0.5 V
Input impedance	: 360 Ω
Input photocoupler	: TLP421 (TOSHIBA)
Forward voltage (V_F)	: 1.2 V typ.
Forward current (I_F)	: 16 mA typ. (70 mA max)

NOTE:

When using input signals of 7.0 V or higher, prepare a trigger protection resistor (R_{ex}) by referring to the calculation formula below. (Also see the block diagram on page エラー! ブックマークが定義されていません。 for the position to install the trigger protection resistor.)

$$\text{Formula: } (V_{in} - 1.2V) / (360\Omega) < 70\text{mA}$$

V_{in} : Input signal voltage

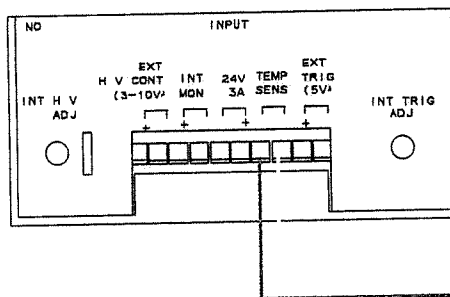
6-1-11 Connection to cooling jacket (Model: E6611)

When the Lamp operating condition at 20 W or more, please do forced air cooling jacket (E6611: sold separately).

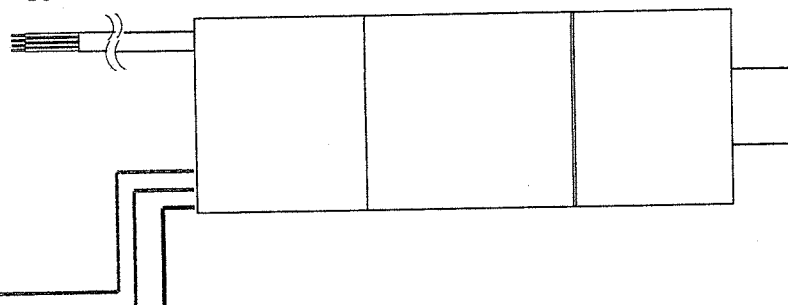
Heat-sink jacket is built-in cooling fan. Rated DC 24 V, 0.1A (Red and Black leads).

Also connect the thermal sensor cable of the cooling jacket (Blue and Yellow lead) to the protective circuit terminals (Thermal sensor cable is no polarity).

NOTE: See ⑤ on page 10 with regard to the protection circuit terminals



Trigger socket (Model: E6647) shield cable (See P.14)



Fan cable (Red/ Black, Rating: DC 24V, 0.1 A)

6-2 Starting the lamp (discharge)

When a DC voltage of 24 V (3 A) is supplied from the input power supply and main discharge voltage and trigger signals are input, a voltage is simultaneously applied to the xenon flash lamp to start discharge.



CAUTION



- When working near the emitted light, always wear protective devices (conforming to JIS-T8141 or equivalent regulations). The lamp in operation emits intense ultraviolet and infrared rays which are harmful to the eyes and skin. Looking directly into the emitted light or allowing the light to fall on the skin will damage eyesight or cause skin burns. Never directly stare into the operating lamp.
- When designing the lamp housing and equipment, they must have structures that prevent hazards from flying glass fragments in the event the lamp ruptures.



CAUTION

When used in a closed room, be sure to provide adequate air ventilation.
UV radiation emitted from the lamp decomposes the air and generates nitrogen oxide (NO_x) and ozone (O₃) harmful to the human body.

6-3 Warm-up

The radiant output intensity of the xenon flash lamp exhibits slight variations (drift) until the lamp reaches a state of thermal equilibrium. The lamp normally reaches a stable state about 10 to 20 minutes after start-up, although this also depends on the ambient temperature and operating conditions, etc.

6-4 Turning the lamp off

To turn off the lamp, stop supplying the 24 V DC to this power supply.

7. Power supply characteristics and specifications

■ GENERAL

Input voltage (DC)	24 V \pm 5 %
Input current (DC)	3.0 A (at 24.0 V input)
Output capacity	60 W Max.
Operating temperature	0 °C to 40 °C
Performance guaranteed temperature	5 °C to 35 °C
Operating humidity	Below 85 % (no condensation)
Cooling	Natural cooling
Storage temperature	-10 °C to +60 °C
Storage humidity	Below 85 % (no condensation)
Dimensions	(W) 108 mm \times (D) 174 mm \times (H) 49 mm
Weight	Approx. 534 g
Location for use	Indoor

■ Main discharge power supply section

Internal main discharge voltage (DC)	300 V to 1000 V
External main discharge control signal (DC)	3.6 V to 10.6 V (output voltage: 300 V to 1000 V)
Ripple	\pm 0.5 % or less
Main discharge capacitance	0.1 μ F

■ Trigger power supply section

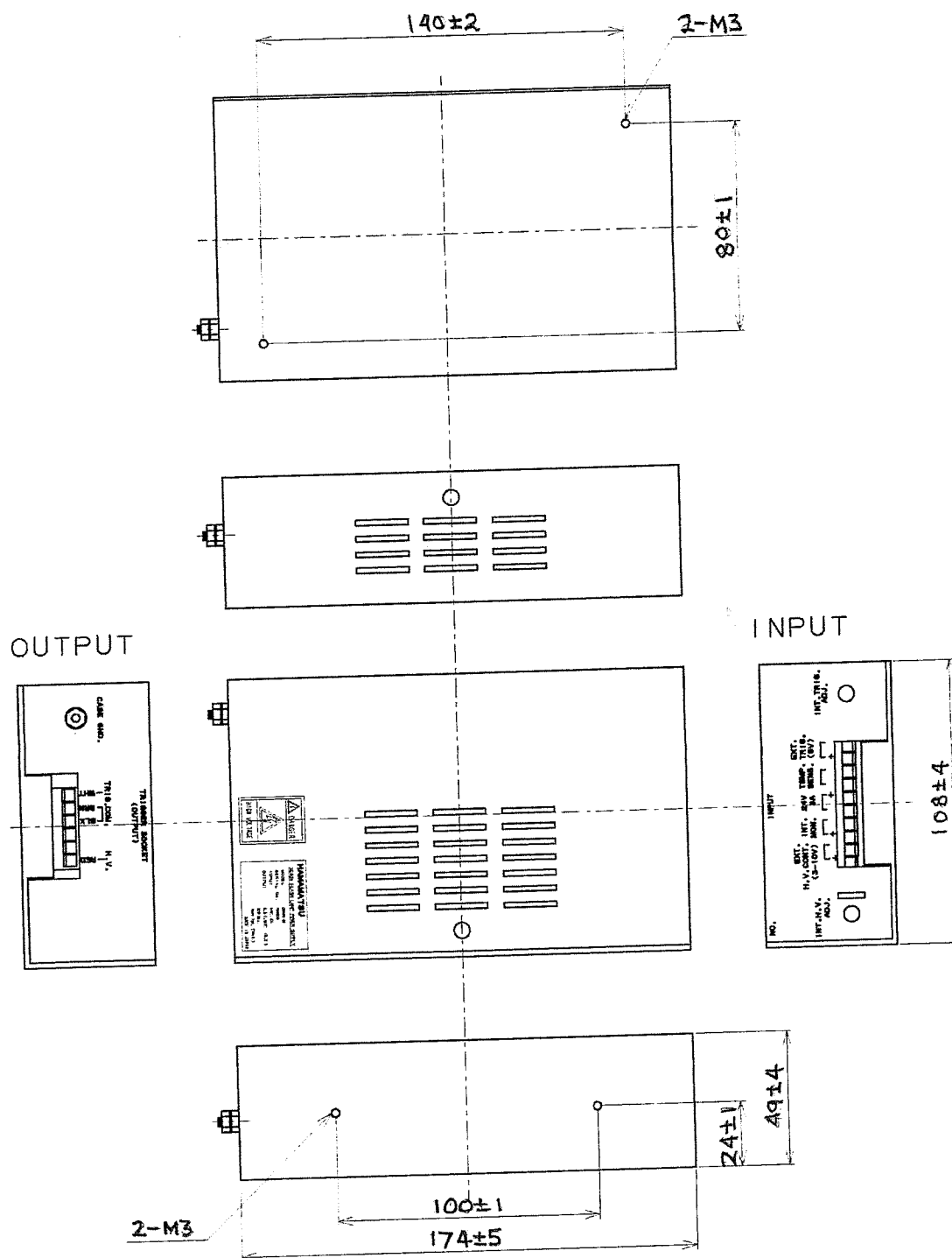
Trigger output voltage (DC)	180 V Typ.
Trigger capacitance	0.22 μ F
Trigger signal mode	Internal/External
Internal trigger adjustment range	Approx. 10 Hz to approx. 100 Hz
External trigger input impedance	360 Ω
External trigger control signal	Rectangular wave (synchronized with rising edge of minimum width of 5 μ s)
External trigger control signal voltage	5 V \pm 0.5 V
Maximum repetition rate	100 Hz (at 1000 V and 1.1 μ F*)

*Internal 0.1 μ F + External 1.0 μ F

NOTE

1. Above specifications apply to operation at an ambient temperature of 23°C \pm 5°C.
2. Specifications are subject to change without prior notice due to performance improvement.

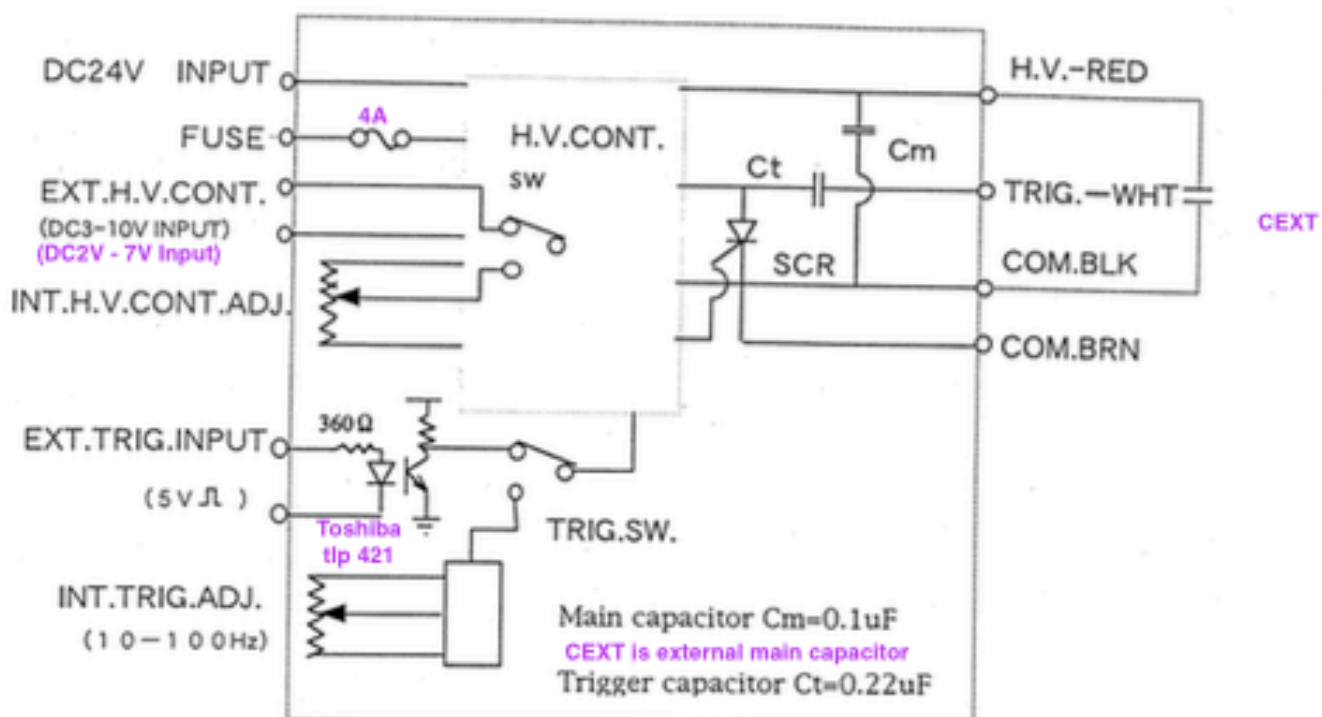
8. Dimensional outlines



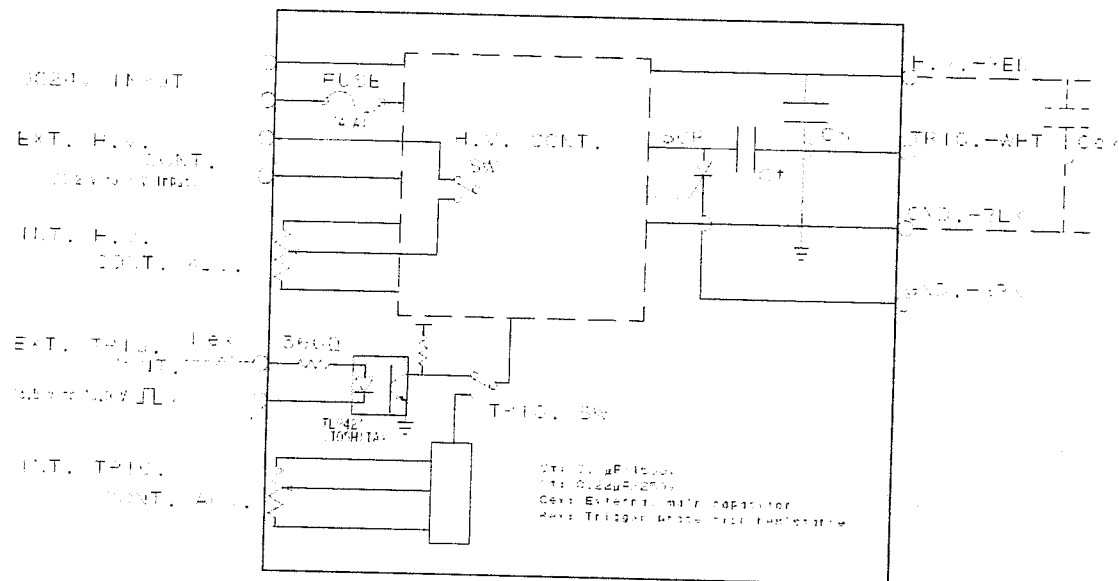
Unit: mm

13. BLOCK DIAGRAM

The diagram in the 6096-02 manual is illegible. I have included it (next page) to show this. This is from the 6096 manual - there is an indication for a series resistor ahead of the 360 Ohms in 6096-02 manual. Purple are additions from the 6096-02 manual.



9. Block diagram



10. Warranty and after-sales service

Warranty

This power supply is warranted for a period of one year from the date of delivery. Should any failure or trouble be found in the workmanship or materials within this warranty period, Hamamatsu will repair or replace the defective parts without charge. The warranty shall not apply to failure in the following cases. Even if within the warranty period, you will be charged for repair or replacement in the following cases.

- (3) Failure or trouble was caused by misoperation or mishandling that did not comply with instructions and precautions described in this manual.
- (4) Failure or trouble was caused by electric or mechanical modifications performed by the customer.
- (5) Failure or trouble was caused by accidents such as natural or man-made disasters.

This warranty is limited to repair or replacement of defective parts or power supply.

After-sales service

If a defect or trouble has occurred after extended periods of operation due to long-term wear on replaceable parts, ship the product back to us for repair, replacement or adjustment.

If a defect is found in the product or you suspect possible trouble, contact our sales office providing us with the model No. (C6096-02) and production serial No. as well as the specific symptom and detailed description of the trouble. This will help reduce the cost and time required for repairing and adjusting the product you returned.

While every effort is made to repair the returned product in as short a time as possible, the repair of a product which was purchased a long time ago may require additional time. Please acknowledge that repair of a product using parts not in current production or a product which has been modified or severely damaged by the customer may be refused.

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